

## Chapter 5 - Representations of Indigenous Science in Textbooks, Curriculum Resources, and Government Documents

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Imagine what it would be like to never see anyone or anything familiar in science textbooks or science activities—to never see your ancestral heritage and never learn about the richness of Indigenous Science (IS) in the classroom. Imagine what it would be like to never see a famous environmentalist, astronomer, engineer or chemist of Indigenous ancestry. For hundreds and thousands of years, Indigenous mothers the world over, where willow trees grow, gave their children willow bark tea when they had fevers. We now know that willow bark is a mild analgesic that contains acetylsalicylic acid, the same ingredient in aspirin. However, encyclopedias and science textbooks credit Charles Gerhardt of Germany with the “discovery” of aspirin (acetylsalicylic acid) in 1853. As Roberta Barba et al., (1992) ask, “Who really discovered aspirin?” (p. 26).

Books and materials in Canadian schools do not accurately depict the history, cultural diversity, worldviews, and philosophies of Indigenous peoples. As Marie Battiste (2000) states:

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Although some provinces have made great strides in correcting the blatant racism found in texts, the truth is still obscured in favour of a more rational and polished early existence in Canada. Beautiful images of Aboriginal peoples in Native regalia cannot be allowed to subvert the historical truth that publishers wish not to discuss. Published texts obscure the Aboriginal history, cultures, and languages while perpetuating the myth of an empty land in the New World that was ripe for discovery by European explorers. Kits and thematic units prepared by public education in some areas of Canada depict a prehistoric life of Aboriginal peoples, complete with teepees, skins, animal bones, rock tools, and arrowheads. Aboriginal peoples are depicted as primitives, gone after the arrival of the early settlers of working their way toward assimilation in urban areas (p. 200).

In many elementary schools in Canada, you are likely to find that teachers are working hard to incorporate elements of IS in the classroom. That is because science educators have recognized the need to ensure science textbooks and curriculum resources used in classrooms deliver more accuracy in acknowledging the contributions of Indigenous Knowledge to the body of knowledge we call science. Although much has changed, a great deal more needs to be done to accurately and adequately present the culture, worldview, and science of Indigenous peoples in books and instructional materials. The best way to ensure greater accuracy is to involve knowledgeable Indigenous people (Elders, knowledge holders, and Indigenous scientists and teachers) in some stage of the production of those books. Without Elder direction, IS can be misrepresented and loses its context, location and its spiritual base (Battiste, 2002; Battiste & Henderson, 2000; Little Bear, 2009; Michell, 2005; Simpson, 2004).

Publishers target textbooks to province-wide or statewide mandated curricula. These teaching materials are generated for mass markets spanning regions and continents. Consequently, minority cultural representations of authentic place-based science are almost completely absent in bulk printing. For many Indigenous students, conventional science courses are seen as lifeless and mechanical, comprised of memorizing unconnected facts and formulas, taking tests and answering questions from the back of the book. The process has very little to do with their lives. Alienation from science, as it is conventionally taught, is widespread among Indigenous students, and to a considerable degree, amongst non-Indigenous students as well. This affects student performance as indicated by low test scores and limited participation in upper level high school science courses.

Curriculum that is culturally strong embeds a view consistent with a given culture and is relevant only to that culture because of its site-specific nature (Davison & Miller, 1998). Aboriginal students rarely if ever receive science instruction in their own language. Mason and Barba (1992) assert that bilingual students cannot create appropriate schema of concepts, models, and drawings that are presented in English. The use of culturally appropriate place-based content makes the curriculum relevant to the students' interests and provides a structure for the curriculum that systematically builds on the students' culturally embedded background knowledge.

### BC Ministry of Education Science Curriculum

The newly revised science curriculum for British Columbia (2015) makes references to Aboriginal knowledge and worldviews, and encourages teachers to take a place-based approach to teaching and learning:

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The curriculum takes a place-based approach. Science will develop place-based knowledge about the areas in which they live, learning about and building on Aboriginal knowledge and other traditional knowledge areas.

The importance of home-place is a predominant theme in Aboriginal education, as the Aboriginal people interacted with the places in which they lived over millennia. The land is the basis of Aboriginal knowledge. A place-based approach encourages teachers and educators to incorporate local examples of traditional knowledge and wisdom, and to encourage collaboration with Elders and knowledge holders. In addition, the document acknowledges Traditional Ecological Knowledge (TEK) and includes a few examples of TEK in its prescribed learning outcomes, encouraging this type of side-by-side relationship.

There are some references to traditional foods, traditional plants and traditional stories. However, at present, there is little connection between the Ministry's "First Principles of Learning" statement and the required "big ideas" (knowledge statements) students are expected to learn. Teachers are given very little help to incorporate examples of Indigenous Science knowledge and processes into their teaching. For example, in relation to the Grade 5 unit on astronomy, teachers are encouraged to incorporate "local Aboriginal teachings and stories about the Sun and Moon," but are not provided any examples of local stories or how such stories might be used to teach science concepts. Curriculum for grades at the elementary, middle and secondary level include no mention of Aboriginal examples. Numerous potentially rich opportunities are missed, for example, the Grade 5 unit entitled "Simple Machines" includes no mention of Indigenous "simple machines," tools or technologies. The writers could have included the Nisga'a fish wheel; splitting cedar planks using wedges, crossbars and mauls; or raising massive house beams using a fulcrum, levers, inclined plane and manpower.

Overall, the representation of Indigenous Science trends to be piecemeal, often as isolated examples and not as a coherent whole. Consequently, the teacher has to work hard to find materials to supplement lessons. Success on most topics continues to rely on teacher creativity, resourcefulness and endurance.

While it is significant that teachers are given the mandate to incorporate TEK into the science program, TEK has often been presented as traditional or primitive, or in the past. Although much has changed over the past decade, a great deal more needs to be done to accurately and adequately present the culture, worldview and science of Indigenous peoples in ministry guides and curriculum resources. It is the responsibility of ministries of education and territorial governments to include a meaningful degree of Indigenous Science explicitly in the science curriculum K-12. Ministry documents and web sites should include ample information on Indigenous Science, information about Aboriginal worldviews, and teaching strategies that facilitate responsible cross-cultural science education. Without the necessary support and infrastructure such as adequate funding for curriculum development, resources and workshops, classroom teachers feel ill-equipped to carry out such a mandate.

The BC Ministry of Education web site states, “Eventually, once developed, rich examples of teaching and learning will be included in the web-site to show examples of relevant teaching units and place-based learning.” Hopefully, with guidance from Elders and knowledge holders, these “rich examples of place-based learning” will incorporate numerous examples and cases of Indigenous Science, thus easing the transition from middle school, to secondary school and university for Aboriginal students. Academic success in science and mathematics is a critical first step in opening the doors to science careers. In order to open the doors of access to science careers for Aboriginal students, the difficulties at the school and district level must first be understood, addressed and continually attended to by the ministries of education and territorial governments. This must be a continual and active process of enabling all our children and future generations to understand more clearly the vitality and fundamental importance of Indigenous Science.

## Science Textbooks and Publishers

There is a small but growing number of Canadian book publishers working to meet the demand for science textbooks with an Aboriginal voice. One of the publishers is McGraw-Hill Ryerson that published *BC Science Probe 6*, (Mason et al., 2005) and *BC Science Probe 7* (Mason et al., 2004). The acknowledgements page credits many contributing Elders and knowledge holders who provided examples of TEK. Importantly, the Grade 7 textbook provides an overview of TEK, as follows:

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The spiritual connections among all living things, combined with the centuries of Aboriginals’ experience and observation of their environments, means that vast bodies of knowledge about their environment have been gathered. Traditional Ecological Knowledge, as it is called today, is important to a full understanding of environments, species, and ecosystems. TEK is based on the following ideas:

- Creator made all things one.
- All things are alive, related, and interconnected.
- All things are sacred and should be respected.
- Balance and harmony are essential among all life forms. (p. xxi)

The section explains that TEK has contributed a great deal to the sciences in the Americas, and lists cotton, corn, chocolate, beans, squash, more than 3,000 species of potatoes, rubber, and many medicines that have found their way into the medicines we use today.

Both texts include photographs depicting examples of Aboriginal technologies: a dugout cedar canoe, a woman tanning a moose hide to make moccasins, a woman removing a strip of bark from a cedar tree to make cedar baskets, a birch bark canoe, a birch-bark basket, snowshoes, a woman using a drawknife to scrape a hide, an obsidian arrow head.

Textbook publishers need to be careful in the way that IS and technology is portrayed alongside WS and technology. In the Grade 6 text, the section on “Canadian Technologies” includes impressive photographs of robots used to design and test robots, Dexter (the robot), with arms that reach in different ways in action on the International Space Station and an astronaut attached to the Canadarm as he moves towards the Hubble space telescope. The section on deep-sea exploration features a micro-submersible called Deepworker and a recent version of a revolutionary diving suit for deep-ocean exploration (the Newtsuit), both designed by Vancouver engineer Phil Nuytten. Information that is not included is that Nuytten is a world-renowned scientist of Aboriginal ancestry. A Métis raised in Vancouver, he apprenticed with Kwakiutl carvers from the age of 12, is a skilled carver, and has taken an active role in preserving the First Nations cultures along the northwest coast of BC. Most likely, this information was unknown to the writers, but the inclusion of a highly successful scientist and engineer of Aboriginal ancestry would have served as an important role model for young Indigenous students considering science-related careers.

An important innovation in both texts is the “Ask an Elder” section that includes interviews with Elders and knowledge holders. For example, in the Grade 6 text, Barbara Wilson, a Haida Elder, is interviewed regarding her work as an expert in the conservation of nature and cultural resources on Gwaii Haanas. Wilson explains that if a scientist might be going into the National Park Reserve to do research on the land, “then a Haida goes along too. We both learn something. The Haida learn what we need to from the scientific world, and we also teach the scientists from the Haida perspective. It shows we can look after the land together” (p. 89). The inclusion of such Elder interviews is crucial because it helps to bring Indigenous Knowledge into a modern context.

Chapter 3 of the Grade 6 textbook devotes 29 pages to “classifying living things,” of which over 28 pages explain the Linnaean system of classification that divides types of organisms into a series of increasingly specific categories, or levels of organization: *Kingdom, phyla, classes, orders, families, genera* (singular *genus*), and *species* (singular, also *species*). The section “Other classification Systems,” which consists of less than half a page, explains how “different peoples of Canada have classification systems that are more detailed than scientific classification.” For example, “the Nuuchah-nulth people of the west coast of Vancouver Island use one classification for when this fish lives in the ocean and one for when it lives in fresh water” (p. 66). Additional and more in-depth examples of Indigenous classification systems and language terms would have illuminated an intimate knowledge of plants, animals, and environmental relationships.

Although the McGraw Hill-Ryerson publications fall short of the ideal science textbooks for both Indigenous and non-Indigenous students, the publisher took a giant step forward by involving Elders in the development and presentation of the text and by including information that explains interactions between Aboriginal people and the ecosystem in which they live, respecting the wisdom of Elders, and respecting other cultures.

While there has been progress made in creating Canadian textbooks that more accurately reflect IS and culture, those changes have involved very few publishers and provinces. Teachers continue to complain that: “You don’t have individual units made up like you do for the regular science units. Resources are hard to find.” There are some resources that look at Indigenous health and foods, traditional use of plants and traditional stories, but overall the teacher has to work hard to find materials to supplement lessons. While this is less of a problem in Indigenous

communities, the demand for Elder visitations in the classroom, Elder-led fieldtrips, and hands-on experiential learning in mainstream schools increasingly stresses a dwindling population of Elders and knowledge keepers. Success on most topics continues to depend on teacher creativity, resourcefulness, and endurance.

Although some textbooks have included Indigenous examples, these continue to be presented as short items of interest and not cohesively. As Simpson (1999) describes, TEK has often been presented as primitive or of least importance, while WS and other contributions of western society are represented as industrialized, modern, and advanced. Many textbooks and ministry documents still contain language that privileges WS simply by what they leave out, that being terms such as “Indigenous Science” or “Native Science” and using terms such as “Indigenous Knowledge,” “cultural knowledge,” or “traditional technology.” Textbooks need to be sensitive to the fact that language is a currency of prestige and power. One way for textbooks (and teachers) to reduce this power imbalance is to acknowledge that it exists, and to use terms such as “Indigenous Science” or Native Science” to promote greater equality with terms such as “Western Science,” “Modern Science,” or “Eurocentric Science.”

These findings are similar to those of Michie (2005) who reviewed Australian science textbooks and concluded, “The representation of indigenous knowledge tends to be piecemeal, frequently inserted for its exotic nature (or to fill an editor’s whim to be inclusive), and often as an isolated illustration and not as a cohesive whole” (Michie, 2005, p. 2). Similarly, Ninnes (2000, 2001; Ninnes & Burnett, 2001), reviewed Canadian, Australian and New Zealand textbooks and identified three main issues: the masking of diversity within the Indigenous population, the representation of Indigenous people as “traditional,” and the location of indigeneity through past tense when describing Indigenous Knowledge.

### The Collaborative Approach to Successful Implementation

The will to implement cross-cultural school science is being accomplished in several provinces in Canada, especially in the province of Saskatchewan. Beginning in 2005, the Ministry of Education embarked on an ambitious program to enhance the quality of school science for non-Indigenous students (Aikenhead & Elliott, 2010). A key element was piloting a draft curriculum in schools across the province, including First Nations band-schools and rural and urban schools with Aboriginal teachers. Indigenous Knowledge content was introduced in ways that relate to the required science topics at each grade. A separate committee was formed to examine how place-based Indigenous Science could be applied within the established school curriculum (Michell et al., 2008). The results informed a rewrite of the overview to Science 6-9, particularly the section on science, technology, society (STS), and the environment relationships. Indigenous groups were asked to find connections between a scientific topic and Indigenous Knowledge that could be associated with the pre-determined topics. In this way, the Indigenous people of Saskatchewan negotiated what Indigenous Knowledge would be appropriate for the renewed science curriculum, and this new content was included in Ministry documents (Aikenhead & Elliott, 2010, p. 16). As well, the *Pearson Saskatchewan Science* textbook series was developed to emphasize Indigenous perspectives and support cross-cultural science curricula (Aikenhead & Elliot, 2010). Clearly, transformation of schools does not happen on the initiative of teachers alone; it happens when teachers, curriculum developers, Elders, textbook companies and government work in partnership.

### International Science Curriculum Innovations

The last two decades witnessed an international renaissance in which Indigenous cultures began to assert their human rights and sovereignty (McKinley, 2007; Niezen, 2007). In the realm of education, this movement has

called for the inclusion of Indigenous Knowledge in science courses and curricula for all students. There are many examples where changes have been made and some are detailed below.

In the United States, some jurisdictions have placed Indigenous Knowledge in their science curricula. The Alaska Native Knowledge Network (ANKN, 1996) has produced an impressive set of cross-cultural teaching materials for Yupiaq students and beyond, whose standardized test scores uniformly improved over four years to match the US national average (Barnhardt et al., 2000). Units include: “Observing Snow,” “Village Science,” “Tools Project,” and “Birds Around the Village”; all units that can be easily integrated into the British Columbia science curriculum. Chinn (2007, 2008) used Hawaiian traditional knowledge as a foundation to develop an environmental literacy program for K-12 science curricula that met standards-based expectations. Importantly, when culturally responsive instruction included outdoor science instruction, rather than indoor instruction, standardized science test scores improved significantly for Indigenous students, and became on par with their non-Indigenous counterparts (Zwick & Miller, 1996).

In 1992, the Aotearoa, New Zealand science curriculum was translated into Māori and taught in designated schools (McKinley, 1996). A Māori version of their country’s science curriculum was developed in 1992 and was implemented in a network of Māori bilingual and immersion classrooms in elementary and high school (Wood & Lewthwaite, 2008).

Australian national curriculum policies explicitly support including “Indigenous Science” in school science (Michie, 2002). The policies inspired collaboration between science educators and Indigenous family groups across Australia to produce a high school textbook *The Kormilda Science Project*. A second approach produced “Australian Indigenous Science” as chapter 1 in a junior secondary textbook *Science Edge 3* (Sharwood & Khun, 2005).

In Africa, several studies and curriculum projects have integrated Indigenous Knowledge systems into school science programs. For example, in South Africa, Eurocentric science content was embedded in local cultures, and student interest and achievement increased (Jegede & Okebukoa, 1991; Pabale 2006). As a result, South Africa established the goal of teaching local African knowledge of nature in science classrooms (Keanne, 2008).

## Canadian Science Curriculum Innovations

In Canada, a number of science-related curriculum projects recognize Indigenous ways of knowing nature to be foundational content in school science. In British Columbia, *Forests and Oceans for the Future* (Menzies, 2003) combined IK and WS by developing teaching materials that facilitate the sharing of knowledge and understanding of the issues, controversies, and concerns related to forestry and natural resources. The materials were inspired by the experiences of students and community members living in the Tsimshian territory. Additionally, the Saanich Indian Band School published the teachers’ guide *Reef Net Technology of the Saltwater People (1994)*, by Earl Claxton Senior and John Elliott Junior. This well-written curriculum covers sacred beliefs of the WSÁNEĆ (Saanich) people, the origin of the reef net, reef net technology, ceremonies, moons and tides, the arrival of the first immigrants, and breaking historical ties to the land.

Songwriter and singer Holly Arntzen has produced several curriculum handbooks and CDs focusing on west coast environments with an emphasis on environmental education and Traditional Ecological Knowledge. The resources include: *Running from the Mountains CD* (1999), with lyrics describing First Peoples’ view of the natural world; *Salish Sea: A Handbook for Educators K-7* (2000) includes lessons and lyrics based on the creation myth of the Cowichan Tribes; *Cycles of Life/Recycle Handbook: K-6* (2003) includes a story about the Haida tradition

of taking reusable utensils to a feast and lyrics portraying how First Peoples survive the harsh Arctic ecosystem; *Shade of Our Trees CD* (2006), includes lyrics about the significance of the cedar in Aboriginal culture; and *The Watershed Song Education Handbook* (2016) includes lessons and lyrics calling for action to help protect habitats, waterways and ecosystem. Arntzen emphasizes the importance of wild salmon and waterways to First Peoples, incorporating a discussion of Aboriginal worldview. The CD *I Am the Future* (2010) includes First Nations place names, villages, rivers, and a holistic view of the world.

Oceans Network Canada, a major initiative of the University of Victoria, is actively building Ocean Sense education programs that embrace diversity of ocean sciences for Grades 6 – 12. Students discover the changes that are being witnessed in our ocean through underwater tools like cameras, hydrophones, water property sensing, and remote operated instruments. Ocean Sense aims to make ocean sciences more relevant to Aboriginal students by including place-based knowledge and by promoting cross-cultural learning for non-Aboriginal students alike. For example, outreach teams are introducing the latest community observation site on Nuuchah-nulth territory.

Strong Nations Publishing, located in Nanaimo, BC, is considered to have one of the largest selections of Indigenous books on-line. Strong Nations specializes in First Nations, Inuit and Métis stories and topics of interest. In 2012, they started their own publishing house with the launch of their first set of readers, *From the Mountains to the Sea*. Students are invited to come along on the journey of a river-ecosystem. Each title targets the Aboriginal Learning Standards in both science and social studies: in Kindergarten—*We Live Here*, Grade 1—*We Share the Seasons*, and Grade 2—*We are a Community*.

In Saskatchewan, the project *Rekindling Traditions* integrated Eurocentric science into the Indigenous Knowledge of northern Saskatchewan communities to produce six cross-cultural science units for Indigenous students in Grades 6-11 (Aikenhead, 2000, 2002). The units include: “Wild Rice,” “Nature’s Hidden Gifts,” “Survival on the Land,” “Trapping,” “Snowshoes,” and “The Night Sky.” In addition, a major research effort at the University of Saskatchewan produced a comprehensive book *Bridging Cultures: Indigenous and Scientific Ways of Knowing Nature* (2011), by Glen Aikenhead and Herman Michell. The primary audience for this book is science teachers and Native Studies programs, ministries of education, and other policy makers facing the challenges of implementing Indigenous Knowledge into curriculum.

Saskatchewan-born singer Buffy Sainte-Marie sponsored the *Cradleboard Curriculum* as a means to develop teaching materials from a Native American perspective. The *Science Through Native Eyes* (2002) CD series for school science addresses scientific concepts from within Native American culture. For example, the first CD addresses the scientific principles underlying sound, friction, and lodge construction. The “Principles of Sound” unit explores how instruments work. Students explore frequency, amplitude, decibels, and wave-lengths through interactive media, audio, text and animation. Students listen to Native American flutes, drums, rattles, mouth bows, and the Apache violin. A second series of CD ROMs is underway that will contain astronomy, botany, and ideas for careers in science for students of all ethnicities. Students are tested and automatically graded on-line.

In the Northwest Territories, *Inuuqatigiit: The Curriculum from the Inuit Perspective* (Northwest Territories Education, Culture and Employment, 1996) is the foundation document informing curriculum development for Inuit in the Northwest Territories and Nunavut. It advocates that in all subjects, including science, students should learn about Inuit history, knowledge and traditions, and practice Inuit values and beliefs in order to strengthen their education and enhance personal identity (Lewthwaite & McMillan, 2007).

In Ontario, the Native Access to Engineering Program at Concordia University was established in 1993 by the Faculty of Engineering and Computer Sciences to look at ways to address the low participation rate of Aboriginal people within the pure and applied sciences. This groundbreaking program offers science camps for Aboriginal youth and professional development and conferences for teachers that focus on how to encourage and support more youth into the sciences.

In Cape Breton, an initiative called “Integrative Science” is an integrated program involving Cape Breton University, a small group of people on the island of Cape Breton (Unama’ki) in northeastern Nova Scotia and the traditional territory of the Mi’kmaw Nation. The initiative is guided by the principle of “two-eyed seeing” offered by Elder Albert Marshall (Eskasoni Mi’kmaw First Nation) and refers to learning to see from one eye with the strength of Indigenous Knowledge and from the other eye with the strengths of Western knowledge. “Their co-learning journey is committed to using the best of Indigenous ways of knowing and the best of Western (or Eurocentric) ways of knowing to talk and walk together in an ethical, respectful, and productive manner ... as per the millions of people around the world who desire healthier communities and a healthy Earth Mother” (Bartlett, et. al., in press, p. 2).

I have attempted to provide a window into the representation of IS in Canadian textbooks, curriculum resources and government documents. I haven’t analyzed every textbook and there is a possibility that I have provided a somewhat incomplete data analysis for each territory and province. Although cross-cultural science education projects are increasing in numbers, they tend not to be widely publicized. Thankfully, many projects have websites and free downloadable resources. (See Appendix B: Selected Curriculum Websites).

## Possibilities for Transforming the Science Curriculum

Clearly, most governmental jurisdictions across Canada fall seriously short in providing teachers with adequate examples of prescribed learning outcomes that integrate IS examples, procedures and teaching strategies for exploring a pluralistic view of science, and above all, a mandated requirement to teach IS in the classroom. It appears that, with the exception of Nunavut and Saskatchewan, jurisdictions have abdicated responsibility by leaving it up to individual school districts and locally-based curriculum projects to provide guidance and resources. Of concern is that Canada has yet to initiate a comprehensive Pan-Canadian Framework that mandates all provinces and territories to integrate proper representation of IS along with WS in government documents.

It would appear that the most inclusive curriculum resources that provide in-depth coverage of IS examples and philosophy are those that are funded in whole or in part by grants, foundations, universities and ministries or territorial governments. Unlike textbook publications which attempt to receive province-wide adoptions, these curriculum projects are largely free to include Elders in the development and presentation of materials, are place-based, and provide in-depth coverage from an Indigenous perspective. The challenge of designing teaching strategies and curriculum that enables students to understand scientific ideas and practices without destroying identity and religion is great, and the resolution may differ in different contexts and communities.

We have to expand all the programs that work to all public schools Canada wide and to the 633 reserves across the country and look at new strategies. However, a culturally appropriate science curriculum is much more than building a curriculum around the local interests and culture of the learners. Such a local focus can become limited to the science the students want to study. While this local perspective is critical, such an approach can overlook the organization of scientific ideas and preclude the development and teaching of the general curriculum. Thus, an appropriate approach to curriculum focuses on mastery of a broad range of science content at specific grade levels, using examples from both IS and WS that are meaningful and relevant to the students.

Science textbooks need to provide examples of the contributions of Indigenous Science that enabled Aboriginal peoples to live in environments over long periods of time. Similarly, more needs to be done to present Indigenous Science in a modern context; for example, by showcasing Aboriginal engineers, biologists, geologists, environmentalists, or nurses, and by highlighting cases where IS and WS work together, such as combining the use of ancient Nisga’a fish wheel technology with modern satellite tracking and statistical methods to provide more



accurate fish counts, thus enhancing salmon river returns (see Chapter 6). Examples from the history of Western Science can be used to illustrate how the purposes, theories, and methodologies of WS have changed. Teaching materials need to show the limitations of WS, as well as the limitations of IS. When these are omitted, the result is a distorted, romanticized view of WS, which further leaves the students without the necessary concepts and vocabulary for thinking about the complexities and contradictions that characterize science, technology, and society issues.

More needs to be done to understand the role of prior beliefs in concept formation, and to include information related to teaching strategies and the science related beliefs of Canadian Indigenous children in government curriculum documents and teacher guides for science textbooks and curriculum materials. If, for example, teachers understand that many Indigenous children bring to the science classroom ideas about classification that are different from the WS Linnaean system of classification, and that many of their ideas have important ecological implications, then the study of classification systems can have relevance for all students.

There is an urgent need for science curriculum writers to make themselves familiar with the vast body of science literature (papers, research reports and academic books) that provide excellent examples of TEK and IS. By incorporating well-chosen and descriptive examples of IS, curriculum development can become the meeting place of differing worldviews. In this way, future generations of children, who will be the recipients of the new curriculum, will have a broader and more encompassing understanding and knowledge of science, and of what the Indigenous community has to offer in terms of sustainable environments and communities.

Students reading science textbooks are confronted with an ocean of information, and the tide will constantly rise. Typically, reading science textbooks is a passive, individual activity, with simple experiments that the teacher may or may not do, and questions to answer at the end of the chapter. This makes it quite different from hearing Elders speak or listening to a legend or traditional story. Many science textbooks have failed to engage both Indigenous and non-Indigenous students because of the use of technical language and the lack of metaphors. The number of metaphors included in language arts and social studies textbooks is greater than in science books that tend to be literal examples of science achievement and history. Science, like all subject areas, is a way of telling a story; it is a process and structure of thought that is a natural part of human thinking. What is lacking in science textbooks is the use of sufficient metaphorical structures: visual images, metaphorical stories, and metaphorical analogies as bridges to meaning. In short, curriculum writers need to use creativity in presentation, drama, and personal insight in telling the stories of science.

Clearly, there is demand for more culturally responsive science textbooks and resources, and we expect that demand to grow. Including IS in a culturally responsive way can be particularly meaningful for Indigenous students because it engages them in ways that honour their identities, languages, cultures, and values. A co-existing strategy benefits science curricula and pedagogy not only for Indigenous students, but also for all students because it makes science more humanistic and explores the nature of science itself. While the transition to incorporating more IS content and pedagogy into government curriculum documents, science textbooks and curriculum resources might be difficult, the struggle to succeed is worth the effort. What can be more important in education than enabling teachers to nourish the minds and spirits of *all* children?

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